PREHOSPITAL 12-lead ECG- IS IT USEFUL TECHNOLOGY AND HOW DO WE GET OUR PARAMEDICS TO UTILIZE IT?

Advanced Leadership Issues in EMS

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An applied research project submitted to the National Fire Academy
as part of the Executive Fire Officer Program

March 1999

ABSTRACT

The Altamonte Springs Fire Department (ASFD) purchased portable 12-lead electrocardiogram monitor/defibrillators for its Advanced Life Support (ALS) units in 1992 with subsequent purchases made as additional units were placed in service. As part of a comprehensive equipment replacement plan, these units are scheduled for replacement in FY 1999/2000.

The task for selection of new cardiac monitors was delegated to the department's EMS Research and Development Team which hypothesized that prehospital 12-lead ECGs were being underutilized by department paramedics. Descriptive and evaluative research methods were used to identify: a) previous documentation that exists to validate the provision of 12-lead prehospital electrocardiograms (ECGs) and if they affect patient outcomes; b) if the technology is being provided to patients as often as it should be; c) what situations are 12-leads currently being provided; d) what factors influence paramedics in the application of 12-lead technology in our local community as well as nation wide; e) what is the opinion of the local Emergency Medical Services (EMS) system Medical Director concerning the provision and future of 12-lead technology.

The procedures employed for this project included review of written material on the application of 12-lead ECGs; personal interviews; surveys of fire departments both within Florida and nationwide; and surveys of paramedics working within the Seminole County, FL, EMS system.

The findings of the project indicated there is over whelming documentation to support the continued use of prehospital 12-lead ECG technology by ASFD. The literature indicates a definite decrease in "door to drug" times for patients identified as thrombolytic drug therapy candidates, thus having the potential to improve patient outcomes.

The research also indicated several key opportunities for improvement in ASFD's utilization of 12-lead ECG technology. Recommendations were made to increase the level of paramedic training and understanding of prehospital 12-lead application, develop stronger protocols to guide its use and to increase the acceptance by the receiving facility (emergency department) staff of the prehospital diagnostics.

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INTRODUCTION

The Altamonte Springs Fire Department (Florida) began the provision of Advanced Life Support (ALS) Emergency Medical Services (EMS) to the community in 1978. Emergency Medical Transport (fee based) service began in March of 1996. ALS and transport delivery is provided with other fire/rescue agencies located in Seminole County by a unique first response system operating from a common dispatch center.

Marquette brand 12-lead cardiac monitor/defibrillator units were placed in service in 1992 with subsequent units being placed in service as the organization expanded with additional station construction and apparatus allocation. Paramedics were trained to apply the 12-lead diagnostic which utilized a computer interpretation of results, but additional training in providing interpretation and understanding the significance of the results was largely left up to the individual paramedics.

With replacement of these units being provided for in our department's comprehensive financial plan, it was obvious that newer technologies needed to be explored. The task was delegated to the department's EMS Research and Development team. This is a quality improvement group consisting of a cross section of department members that evaluate and make recommendations for purchase of EMS equipment. During their ECG machine research they hypothesized that 12-lead technology may have been under utilized to this point by department paramedics. They also indicated that additional research was needed to look into the value of 12-lead field provision as well as identifying ways to increase the technologies' use and acceptance.

The purpose of this research project was to determine if this technology was being provided as it should be by the paramedics and what factors influence personnel as to whether they use

it or not. Also, the project sought out documentation to validate the provision of 12-lead prehospital electrocardiograms (ECGs) and how they affect patient outcomes. It also obtained the opinion of local medical direction on its purpose and future for prehospital care in our community.

Descriptive and evaluative research sought to answer the following questions:

1. Is the technology being provided to patients as often as it should be?

2. In what situations are 12-leads currently being provided?

3. What factors influence paramedics in the application of 12-lead technology in our community as well as nation wide?

4. What is the opinion of the local EMS system Medical Director concerning the provision and future of 12-lead technology?

BACKGROUND AND SIGNIFICANCE

Altamonte Springs Fire Department

The Altamonte Springs Fire Department provides fire and emergency services including ambulance transport to the municipality of Altamonte Springs located in Seminole County, Florida. The Altamonte Springs Fire Department provides service emplying an operational staff of 60 personnel along with an administrative and support staff of 7 and a Building and Life Safety Services Staff (Building and Fire Inspections, Investigation) of 11. The department operates from 4 stations and utilizes 3 engines, 2 transport rescues, 1 tower truck, 1 heavy rescue and a shift commander serving a resident population of more than 40,000. Altamonte Springs Fire Department is one of 9 fire and

emergency departments within Seminole County. The other departments range in size from a single station municipal department to a 12 station unincorporated county department. This group of departments has functionally consolidated many redundant functions including dispatch and apparatus maintenance. While the local law enforcement jurisdictions oversee the initial 911 Public Safety Answering Point (PSAP), all fire, rescue and ambulance transport is dispatched through the Seminole County Communications Division. The majority of fire rescue agencies also provide ALS and ambulance transport for the residents of Seminole County.

A unique automatic aid agreement ("First Response") exists among all the providers. This agreement eliminates jurisdictional borders and ensures that the closest unit to an emergency incident is sent regardless of where the incident event occurs. An Automatic Vehicle Locator (AVL) System is currently being installed to enhance the system. The departments share a common set of Incident Management Guidelines and Paramedic Practice Parameters (Standing Orders). Many other functions such as Fire and EMS training are standardized and delivered system wide. This system brings together more than 30 stations and 600 fire rescue personnel in a standardized service while still allowing for individuality among the agency participants.

12-lead ECG Monitoring

The Altamonte Springs Fire Department, along with many of the other fire/EMS organizations within Seminole County purchased Marquette brand 12-lead cardiac monitor/defibrillators for it's Advanced Life Support (ALS) units in 1992. These units were equipped with a computer analysis

program of the 12-lead ECG, which was touted as the next major change in the prehospital delivery of Emergency Medical Services.

Initially paramedics were trained on the application of the machines to the patients. Because of the computer analysis capability of the units, and the premise that a "telephone type" transmission system for the data to the hospital would be implemented, instruction on field interpretation of the actual ECG printout by paramedics was limited.

Because of machine age and increasing repair/maintenance costs, it was necessary to anticipate the replacement of the units in the 2000 budget year. Analysis of documentation on chest pain patients in 1998 revealed an extremely low percentage (<10%) receiving 12-lead analysis. The question of the cost versus usefulness and positive patient outcomes needed to be explored.

This paper was prepared to satisfy the applied research project requirements associated with the Advanced Leadership Issues in Emergency Medical Services (ALIEMS) course at the National Fire Academy (NFA). From this research a decision was made to continue delivery of prehospital 12-lead ECGs. Since the evidence proved positive, a plan needed to be developed to increase the use of the technology by department paramedics. Additionally, relevant information will be shared with all the agencies in the Seminole County First Response System and the Seminole County Medical Director for potential system wide application.

LITERATURE REVIEW

Twelve lead ECGs have been used in the hospital and clinical setting for many years to assist in the diagnosis of cardiac related problems. Some of the factors that have prevented the movement into the prehospital setting have included cost, size, power supply sources and the concern that paramedics would be making diagnosis in the absence of a cardiologist. Today these issues have been identified, studied and addressed. Because of recent equipment development, it is now possible to have a portable 12-lead ECG machine that is battery operated, capable of recording and storing data, interpreting the analysis and even cellular transmission. Computer interpretation helps decrease the concern over paramedics making "diagnostic decisions" in the absence of a cardiologist (Mercer, 1993).

The benefits associated with 12-lead ECGs include: identifying the area of the heart involved with acute myocardial infarction (AMI), differentiating wide complex tachycardias, identifying patients with a high risk for developing complete heart blocks, identifying ischemic changes within myocardial tissue, and identifying patients with variant angina that may subside prior to the arrival at the hospital. Another benefit is a decrease in the amount of time elapsed between a patient's entry into the EMS system and the point at which an AMI can be identified and treated with thrombolytics. Paramedics doing prehospital 12-lead ECGs were able to acquire a diagnostic quality 12-lead ECG nearly three times faster than emergency departments. The acquisition of the prehospital ECG resulted in a 5.2 minute average increase in scene time, which can be justified because it results in the AMI patient being diagnosed and transported more rapidly (Mercer, 1993).

Taigman and Canan (1992) also discuss the benefits that a 12-lead versus the single lead approach gives the responsible EMS provider. First, it is nearly impossible to differentially diagnose wide complex tachycardias accurately in lead II and it can be done easily with a 12- lead. Second, it is nearly impossible to identify which patients are at high risk for developing a complete heart block and who may need a pacemaker in lead II, but it can be accomplished with a 12-lead.

Possibly the most important benefit in the EMS setting is to decrease the time from a patient's entry into the EMS system to the time an AMI can be identified and treated with thrombolytic therapy.

Because the benefits from thrombolytic therapy in acute myocardial infarction are time dependant, multiple strategies have been devised to speed therapy. Foster et al. (1994) sought in his study to determine whether hospital-based nurse and paramedic ALS providers could be trained to independently evaluate (sight read) a prehospital 12-lead ECG for the presence of AMI as part of protocol designed to speed in-hospital administration of thrombolytic agents. Providers were required to determine on the basis of protocol (1) whether or not AMI was present, and (2) whether or not thrombolytic therapy was indicated. Providers then radioed their impressions to the emergency department (ED) and initiated a protocol to prepare the candidates for thrombolysis. The final decision to initiate thrombolytic therapy was made by the ED'S physician after patient arrival at the hospital. There were no false positive diagnosis. In-hospital times to administration of thrombolytic therapy decreased an average of 22 +/- 13.8 minutes in the studied group compared with a historical control group average of 51 +/- 50 minutes. It was concluded by this study that paramedics and nurses can successfully be taught to evaluate a prehospital ECG for the presence of AMI with accuracy.

In another study by Keriakes et al. (1992) at Christ Hospital in Cincinnati, it was determined that specialized emergency medical transport alone did not facilitate in-hospital initiation of thrombolytic therapy in patients with AMI when compared with those brought in by local ambulance or by private automobile. However, significant reduction in hospital time delay to treatment was observed in patients transported by the emergency medical system who had the results of prehospital 12-leads transmitted to the hospital from the field.

Studies over the past several years have shown that many patients who died of AMI had thrombotic occlusion superimposed on areas of atherosclerotic narrowing. Thrombolytic therapy has a promising future in the emergency care setting in reversing ischemic injury during AMI. Preliminary data analysis shows that patient entry into thrombolytic therapy within three hours of the onset of infarction has been the exception rather than the rule. Information gathered in the field can help expedite important time-sensitive in-hospital decisions on the administration of thrombolytic agents by the emergency department. A paramedic with 12-lead ECG equipment and the proper training can provide an update of the patient's status to the receiving physician in the form of a preliminary or prehospital checklist. Early recognition of potential candidates by ALS personnel, attuned to new knowledge and trends in critical care have the potential to alter dramatically an otherwise lengthy time frame for the evolving AMI and can expedite the start thrombolytic therapy (Eiler, 1984).

Proper patient selection for thrombolytic therapy is important. Any patient complaining of chest pain lasting for more than 30 minutes or more could be having an AMI, and according to an article in JEMS by Handberg & Rucinski (1992) the paramedic is key is this identification. Obtaining a complete patient history is the first step in identifying potential therapy. Additionally, ST-segment elevation in two

contiguous leads of a 12-lead ECG in the absence of any major contraindications indicates the potential for the use of thrombolytic agents. Recent emphasis has been placed on the role of prehospital providers in obtaining a good early history, proper diagnostics and then relaying the information to the receiving facility physician. Several studies are currently underway to evaluate the application of thrombolytic therapy by paramedics in the prehospital setting and 12-lead diagnostic capability will be a requirement for this exciting new therapy potential. At a minimum for now, however, EMS programs can improve their ability to rapidly identify those patients who may be eligible for thrombolytic therapy, relay this information to the receiving physician and significantly reduce the "door to drug" time for AMI patients in the emergency department.

Both Sharkey et al. (1989) and Kargounis et al. (1989) have shown that the importance of early identification and treatment of patients experiencing an AMI is clearly beneficial. Their studies have shown that the time from the onset of chest pain to hospital administration of thrombolytic therapy can be reduced. This can be accomplished by early identification of patient eligibility by paramedics and notification to the receiving hospitals as well as more efficient management after arrival at the ED.

Foster and Mitchell (1996) discuss their findings that thrombolytic therapy has been shown to produce striking reductions in mortality ranging up to 52 percent. They say however, that the benefits of therapy are extremely time-sensitive, with the greatest benefit being observed within 70 minutes after the onset of symptoms. Unfortunately, most patients will not achieve maximum benefits because of delays in the administration of the drug therapy. Delays in patients seeking care account for the largest single component of the delay. Additional hold ups after the

patient has entered the medical care system constitute another significant cause, and these are potentially

correctable.

The average time from hospital admission to administration of thrombolytic agents in the largest multi center study in the United States has been almost an hour and a half, far too long to be of maximum benefit. (Kereiakes et al., 1992) Devising strategies to reduce times to thrombolysis, and in the process save a significant number of lives annually, was a major focus of Kereiakes research. One of the most effective interventions to emerge from this research to date has been the performance of a prehospital 12-lead ECG. Not necessarily because of treatment options in the field, but because of the impact that the prehospital 12-lead ECG has on what happens after arrival at the hospital. Multiple studies have clearly demonstrated that in-hospital times to thrombolysis are significantly reduced by the performance of a prehospital ECG (Foster, 1994).

Grieff (1998) discusses his findings that in areas with relatively short transport times, patients can be evaluated for AMI and can be delivered prepped and ready to the emergency department (ED), where an emergency cardiac care team is standing by to deliver thrombolytic therapy. In areas where transport times are prolonged, prehospital providers may be administering thrombolytic therapy prior to the arrival in the ED. In either case, in order to make a presumptive diagnosis of acute myocardial infarction, prehospital providers need additional diagnostic and monitoring tools. One of the most important of these is the ability to administer 12-lead ECGs in the field.

In Aufderheide's et al. 1990 study of the Milwaukee County paramedic system it was determined that it is feasible to apply a prehospital 12-lead ECG to most chest pain patients and that prehospital diagnostic accuracy is greatly improved compared with single-lead telemetry. Prehospital 12-lead ECGs also have the potential to significantly increase the diagnostic accuracy in chest pain

patients, approach congruity with ED 12-lead ECG diagnoses, and may allow for consideration of altering and improving prehospital and hospital-based management in the chest pain patient. This study showed that the prehospital 12-lead ECG was easily implemented in the Milwaukee system. It achieved a 98.7 percent success rate in obtaining diagnostic quality prehospital 12-lead ECGs in 94.6 percent of eligible patients and only increased paramedic scene time over that of a respective control group by an average of 5.2 minutes.

In 1992, Aufderheide et al studied 680 adult chest pain patients where paramedics applied 12-lead ECGs. Factors affecting prehospital 12-lead ECG application were evaluated and paramedic application of such was found to be reliable and efficient, and applicable to most cooperative adult prehospital chest pain patients. The study went on to show that prehospital 12-lead ECGs significantly improve receiving facility physicians diagnostic accuracy in myocardial infarction, angina, and non-ischemic chest pain patients. Paramedics and receiving hospital physicians' opinions regarding early application of prehospital 12-lead ECGs during patient evaluation were favorable.

Aufderheide et al 1996 again concluded that prehospital 12-lead ECG diagnostic strategies have been proven feasible and effective, provided they are designed and implemented properly. Careful attention to planning, implementation and process monitoring is paramount to successful program development in EMS systems. This level of attention to protocol development, education, training, coordination of the health care community, objective program assessment, monitoring and continuous quality improvement can serve as a model for other diagnostic EMS programs that may develop as an expanded role for EMS services is identified in the future.

Getting paramedics to move from a single lead approach to the 12-lead approach requires

some leverage. According to Taigman and Canan (1992) the possibility of being able to make better clinical decisions based on more accurate information has not been enough leverage to create the needed change in the majority of EMS professionals. Possibly new technology can provide the needed leverage to inspire field personnel to become more open to educational programs that allow them to identify which patients need specific treatment and which ones need to be left alone. They continue to comment that while strong medical directives (protocols) may be established pertaining to the use of prehospital 12-leads that it will take a genuine understanding of the technology through educational programs and seeing positive outcomes in the patients that are treated, before a change can truly take place.

PROCEDURES

Definition of Terms

For the purpose of this study the following definitions are applied:

AMI: Acute myocardial infarction, condition caused by the occlusion of one or more of the coronary arteries, generally by a clot

ECG: Graphic tracing of the electrical forces produced by the heart

Ischemia: insufficient blood supply to the heart muscle

Thrombolytic: A pharmacologic agent capable of dissolving the blood clot causing a myocardial infarction.

Research Methodology

The research methods used in preparing this paper began with a literature review in the Learning

Resource Center (LRC) at the National Fire Academy. Additional literature review was conducted at the Altamonte Springs Library, the Seminole Community College Library in Sanford, Florida, and the Altamonte Springs Fire Department's periodical resources. The literature review was supplemented by Internet searches for journal articles dealing with the subject.

The literature review focused on two major areas: to see what previous documentation exists to validate the provision of 12-lead prehospital electrocardiograms (ECGs) and if they affect patient outcomes.

Subsequent to information request letters, interviews were conducted with Dr. Ron Brown, Medical Director, Seminole County EMS and Marge McKeever, R.N., Head Nurse of Florida Hospital Altamonte Emergency Department located in Altamonte Springs, Fl.

A survey instrument entitled "12-lead ECG Survey" (see Appendix A), was developed and sent to each of the 175 Paramedics working within the Seminole County Florida Emergency Medical Service System along with a letter (Appendix B) explaining its purpose. Specific questions asked included: (a) does the respondent routinely use 12-lead ECGs; (b) in what situations are 12-lead ECGs used; (c) what was their opinion as to whether the technology is utilized as much as it should be; and (d) if they indicated a negative response on the previous question to check and/or list specific reasons which they felt impacted their response. Of the 175 surveys, 62 (35.4%) were returned. All 62 of the returned surveys were validated for usable data.

A modification of this survey (see Appendix B) was also developed and sent to 210 Fire Departments. The mailing list for these agencies was provided by various methods including student lists from numerous Executive Fire Officer courses at the NFA and the Florida Fire Chiefs Association

member list. An effort was established to include departments of various sizes and geographical makeup (urban and rural). A letter was provided (see Appendix D) to explain the purpose of the survey and a self addressed stamped envelope was provided to facilitate the survey's return. Specific questions that were asked included: (a) size of the department; (b) the type of EMS services provided to the community; (c) if the department provided 12-lead ECG monitoring; (d) if the responder felt that their department paramedics utilized the technology as it should be; and (e) if they indicated a negative response on the previous question to check and/or list specific reasons which they felt impacted their response. Additionally, it was requested that documentation of any programs, policies or procedures concerning the subject manner be provided with the survey's return. Of the 210 surveys, 92 (44 percent) were returned. Of the 92 returned, 65 (31 percent) provided completed usable data. 27 surveys were discarded because the surveyed department did not provide ALS services (see question #2 on the department survey).

Assumptions and Limitations

The research was limited by the following factors: while the low number of returns for both surveys did not provide a true representation of all available opinions, it is conceded that the results would not have significantly differed. Obviously, 12- lead ECGs could only be provided by an agency that provided Advanced Life Support (ALS) and employed paramedics for the provision of that service. For this reason the surveys that indicated the agency did not provide ALS services were discarded.

It was assumed that the larger the department the more likely they would be to provide additional services or higher levels of technology. In actuality the data collected showed 12-lead technology to be utilized across various department sizes uniformly and thus results by department size will not be listed individually in this report.

RESULTS

Answers to Research Questions-

Paramedic Survey

1. Do you routinely use 12-lead monitoring?

Yes: 23 (37%) No: 39 (63%)

2. If so, what situations do you use it in? Check all that apply

Non-Traumatic Chest Pain- All Patients: 21 (34%) Over age 45: 11 (18%)

Traumatic Chest Pain- All Patients: 3 (5%) Over age 45: 2 (3%)

Syncope: 16 (26%) Weakness: 12 (19%) Gen. Illness: six (10%)

Other: No additional responses

3. In your opinion, do paramedics within your EMS system utilize the technology as often as it could be used?

Yes: Nine (15%) No: 38 (61%) Unsure: 13 (21%)

4. If you answered No or Unsure to #four, please check or list those reasons which you feel apply.

8 (13%)	Protocols are not strong enough
14 (23%)	Complacent attitude
19 (31%)	Paramedics not comfortable with application
22 (35%)	Paramedics not comfortable with analysis/interpretation
34 (55%)	Emergency Departments lack of acceptance of prehospital diagnostics
43 (69%)	Paramedics feel they are too close (geographically) to Emergency Dept.
6 (10%)	Doesn't change patient treatment
6 (10%)	Time delay in transport
3 (5%)	Miscellaneous

Fire Department Survey

Note: 27 surveys indicated they did not provide ALS service and were discarded

1. Identify the size of your department

Less than 50: 18 (28%) 51-100: 14 (22%) 101-250: 17 (26%)

251-500: 3 (5%) Over 500: 13 (20%)

2.Identify the EMS service you provide

BLS: (27) ALS first response: 12 (18%) ASL transport: 53 (82%)

3.Do you provide prehospital 12-lead ECG monitoring/Analysis?

Yes: 43 (66%) No: 22 (34%)

If you answered NO, you do not need to continue

4. In your opinion, do your paramedics utilize the technology as often as it could be used?

Yes: 24 (56%) No: 17 (40%) Unsure: 2 (5%)

5. If you answered no or Unsure to #4, please check or list those reasons which you feel apply.

5 (12%) Protocols not strong enough

9 (21%) Complacent attitude

7 (16%) Paramedics not comfortable with application

6 (14%) Paramedics not comfortable with analysis/interpretation

10 (23%) Emergency Departments lack of acceptance of prehospital diagnostics

11 (26%) Paramedics feel they are too close (geographically) to Emergency Dept.

1 (2%) Not able to transmit data to Emergency Department

DISCUSSION

Since a great many deaths occur outside the hospital, the concept of the coronary care unit has been extended to the prehospital setting. In the mid to late 1970s, many communities began to equip their rescue squads with cardiac monitor/defibrillators and train their staff to recognize and treat lethal dysrhythmias. While both the coronary care unit and prehospital defibrillation have proved to be effective strategies in reducing cardiac related deaths, neither actually treats the underlying cause, which is an occlusion of the coronary artery.

In the 1980s, angioplasty and emergency coronary artery by pass graft surgery offered the first available means by which the infarct process could be halted. While studies have demonstrated both

methods to be effective in the treatment of AMI, in many hospitals neither option could be provided. Thus, although a "direct" treatment did exist, it was not always available. Accordingly, in many areas of the country, dysrhythmia suppression continued to be the primary thrust of infarct treatment.

In the 1990's studies began to show that thrombolytic drugs could also be used to reduce the mortality seen with myocardial infarction. Several investigators, examining large patient populations, demonstrated reductions in mortality and morbidity when these agents were used in the early hours of infarction. These results were confirmed in subsequent studies and a clearer recognition of the time dependance of these benefits emerged. The advantage of the thrombolytics over angioplasty and bypass surgery is basic. The availability and efficacy of thrombolytic drugs bring to every emergency department a treatment that has the potential to stop the process of infarction and restore coronary circulation.

Precisely because a very effective treatment for myocardial infarction is available to physicians that the non physician, emergency cardiac care providers must learn to recognize infarction. Early identification of infarction is crucial because the benefits of thrombolytic therapy are time dependant. The adage "time is muscle" refers to the necessity of infarcting patients to be identified early so thrombolytic therapy can be initiated as soon as possible. To accomplish this task, emergency cardiac care providers must become skilled at recognizing the infarct patient.

AMI is a leading cause of morbidity and mortality in the United States. The principle cause for AMI is thrombus or clot formation in one of the victim's coronary arteries. Recent medical and laboratory advances have enabled emergency personnel to quickly and accurately assess AMI due to coronary thrombosis and therefore, prevent further damage due to myocardial

ischemia. It is widely acknowledged that time is of the essence in diagnosing and treating suspected AMI in order to prevent further damage to the myocardium.

Until recently, diagnosis and treatment of suspected AMI was restricted to hospitals and physician offices. Recent advances in microprocessors and miniaturization have enabled equipment manufactures to produce EMS field capable 12-lead ECG machines. Studies have demonstrated that paramedics can be readily trained to successfully acquire and interpret 12-lead ECGs. This allows the treating paramedic to quickly identify patients experiencing an AMI and direct their treatment accordingly. Early identification of these patients allows for early and aggressive treatment thereby minimizing myocardial damage. Communication and cooperation between field EMS and hospital personnel prevent unnecessary delays and redundant testing. This further decreases the time between identification and treatment.

In an interview with Marge McKeever, Head Nurse of Florida Hospital Altamonte's Emergency Department (April 1999), she related that her particular emergency department had been recently tasked to decrease the "door to drug" time for patients meeting the criteria to receive thrombolytic agents. According to her, this task can only be met with the assistance of the prehospital providers (EMS). In order to meet acceptable time parameters it will be necessary for field paramedics to complete a 12-lead ECG prior to transport. The paramedics should have the necessary training to interpret the ECG and determine via the test results whether they met certain criteria. The paramedic should then complete a Thrombolytic Eligibility Checklist (Appendix E) that has been previously developed by the Seminole County Medical Quality Assurance Office and relay those

findings to the Emergency Department as a "Cardiac Alert" via radio or telephone. Additionally, it was requested that the patients be placed in hospital gowns (supplied in advance by the emergency department), have blood drawn for lab testing and have two large bore intravenous (IV) lines established at a keep vein open (KVO), slow drip rate. Also, the patient should be transported emergency to the receiving facility and the 12-lead printout should arrive in-hand with the patient.

For the hospitals part, once the cardiac alert is made, the hospital will have a cardiac bed ready for the patient, a nurse and doctor with the medication ready and waiting and a cardiac technician with a hospital 12-lead ECG machine at bedside. She also requested that if field personnel medicate the patient prior to arriving (aspirin and nitroglycerine therapy) that the 12-lead be done at minimal pre medication and at best be additionally provided post medication.

On June 7, 1999, Ronald D. Brown, MD, Medical Director for the Seminole County EMS System issued an opinion on the use of 12-lead ECGs by paramedics within his jurisdiction, stating that "early identification and aggressive treatment of suspected AMI can significantly reduce the morbidity and mortality of Seminole County Residents and visitors." He went on to state that all the agencies under the auspices of the Seminole County EMS Medical Director will develop a plan to:

1. Acquire equipment necessary to acquire prehospital 12-lead ECGs
2. Train their personnel in proper use of the equipment and interpretation of data
3. Train their personnel on the aggressive treatment of suspected myocardial ischemia
4. Coordinate with local hospitals to reduce time from patient identification to definitive treatment

Survey Discussion

It seems apparent from the surveys that were returned that there are deficiencies in the use of 12-lead ECG application by prehospital field personnel. This is identified by the results from both the paramedics working within the Seminole County EMS system and by from various EMS agencies from around the nation that responded to the survey. Nationwide, administrators felt that in about half of their particular scenarios that the technology was not being utilized as it should be. This contrasted with the opinion of local paramedic personnel where 84% of those responding felt it was not being utilized or they were unsure it was being utilized as it should be.

There were some similarities between the nation wide and local providers' opinions on the reasons for this. Both groups had a similar response as to the opinion that medical protocols (12% and 13%) were not strong enough. As well, similar opinion occurred when discussing a complacent attitude about the utilization of the 12- lead (21% and 23%). The remarks indicated that this complacency was tied to several other reasons including the hospitals' tendency not to accept the prehospital diagnostics and a lack of understanding that utilizing the 12-lead can actually make a positive difference in the outcome of the patient.

Our local opinion on several issues was much greater than the national opinion in several other areas. The Seminole County group felt that they were not comfortable with applying the machine to the patient (35% vs. 16%) and interpreting the actual test results (35% vs. 14%). Additionally, they felt that the receiving facility's emergency department generally disregarded most of their prehospital diagnostics and generally opted to repeat most of them before definitive treatment began (55% vs. 23%). Most significantly, they felt they were too close to the hospitals and that the time delay acquiring

the 12-lead would not make a significant change in the way they would treat the patient or in the patient's outcome, generally thinking that faster transport times would be the better alternative (69% and 26% respectively)

It was interesting to see that the administrative opinion from a varied sample of fire departments nation wide in several cases did not match the opinion of the local field personnel. An interesting follow up study might entail the comparison of the opinions of field personnel to the administrative opinion obtained in a cross section of a variety of jurisdictions that responded. The outcome might show that the administrators may have a higher opinion of the field providers acceptance of the technology than do the service delivery providers themselves.

The research, through the literature review and discussions with the local hospitals and medical director shows that there is a direct benefit to the patient by providing prehospital 12-lead ECGs. As well, the survey indicated numerous opportunities for improvement for Seminole County's EMS system. Many of the reasons that were given as to why the technology is not being applied as it should may require remediation or modification through an extensive education process. This process should involve field paramedics, EMS administrators, medical direction, protocols and the receiving emergency departments.

RECOMMENDATIONS

The literature review and opinion of the local medical director and hospital clearly indicated justification for the purchase and continued use of prehospital 12-lead ECGs. The Altamonte Springs Fire Department's EMS Research and Development team will be tasked to

analyze the various brands and types of machines available and make a recommendation for the purchase of replacement units.

The various surveys identified several opportunities for improvement in the acceptance and utilization of prehospital 12-lead ECG by both prehospital EMS personnel and the medical staff at the receiving hospitals (Emergency Departments). Subsequent to the initiation of this project all of the Altamonte Springs Fire Department paramedics have been provided mandatory training that emphasized their role in accurate patient identification utilizing 12-leads. Four of our department members attended a "train the trainer" program provided by ACS Acute Coronary Syndrome Consultants, Inc. This program was offered by Tim Phalen, the author of the book entitled *The 12-Lead ECG in Acute Myocardial Infarction*. Mr. Phalen and his company have become nationally known for the quality and simplicity of their training in 12-lead recognition and application for prehospital EMS.

Upon completion of this course these individuals were certified to teach 12-lead ECG application and subsequently provided the training to every Altamonte Springs Fire Department Paramedic. The training included reviewing the aspects of AMI pathophysiology, equipment operation such as proper lead placement (application) and calibration, proper acquisition and interpretation. Additionally, during the training process, proper documentation of the 12-lead, review of forms and additional data to be collected and related to the receiving facility were discussed. Specifically, a system wide Thrombolytic Eligibility Checklist was developed and implemented (Appendix E) as well as a 12-lead mounting form for our present Marquette 12-lead ECG printouts (appendix F).

A main component of the education thrust was to show our paramedic staff the benefits of 12-

lead application and the positive aspect that it will have on patient outcomes. It has been anticipated that since this is now complete and our paramedics are seeing the results of their efforts that the identified problem of complacency will take care of itself. We have already seen a marked increase in the use of 12-lead ECGs for chest pain patients and feel we have made a significant impact in our level of patient care. Through the use of the literature review and the training that was held for the paramedics, we have also shown that even though a unit may be geographically close to the receiving facility, the decrease in "door to drug" time for the patient can be significantly reduced.

Once the paramedic staff became comfortable with both application and interpretation we began a training process to educate our emergency medical technician (EMT) level personnel as well on the application of the machines. This has allowed the paramedics the opportunity to begin their focused assessment much quicker while the machine is being applied by the EMTs, thus decreasing scene time.

During the research, approximately twelve sets of protocols were received from responding departments. These protocols will be forwarded to the Seminole County Medical Quality Assurance Office as well as the Seminole County Medical Director for review and potential application for use in the Seminole County EMS system's Paramedic Practice Parameters. Once this review is complete, it is anticipated that a stronger protocol for the use of 12-lead ECGs will be implemented into our EMS service delivery system.

The last component to be addressed was the hesitancy of the receiving facilities to utilize prehospital 12-lead diagnostics provided to them by EMS system paramedics. As discussed earlier, our main receiving emergency department had been tasked with reducing their "door to drug" times and has become dependant on our paramedics to provide them with this information. We have also noticed

a growing comfort level from the ED physicians that has increased with time since we initiated our training program, stronger protocols and more aggressive field treatments.

Along with the items discussed above, we have also instituted a quarterly case review session with our paramedics where both positive and negative patient outcomes are openly discussed among the paramedics, the medical director and a representative from the emergency department that received the patient. This feedback, thus far has been instrumental in negating the previous perception that 12-lead ECGs only delayed transport time and did not change or have a positive impact on patient treatment.

The overall result has been the aggressive implementation of a program that had originally only been perceived as "nice to have" technology versus the opinion now that it is "required' for quality prehospital cardiac care. We are now seeing 12-lead ECGs applied to almost 100% of our chest pain patients, more aggressive and substantiated use of cardiac prehospital medications and a higher incidence of our patients receiving thrombolytic therapy in the ED.

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Appendix A

Altamonte Springs Fire Department
12-lead ECG Survey- Seminole EMS Paramedics

1. Do you routinely use 12-lead monitoring?

   ❑ Yes ❑ No

2. If so, what situations do you use it in? Check all that apply

   Non traumatic chest Pain- ❑ All Patients ❑ Over age 45 patients

   Traumatic Chest Pain- ❑ All Patients ❑ Over age 45 patients

   Syncope ❑ Weakness ❑ General Illness ❑

   Other_____

3. In your opinion, do paramedics within your EMS system utilize the technology as often as it could be used?

   ❑ Yes ❑ No ❑ Unsure

4. If you answered No or Unsure to #4, please check or list those reasons which you feel apply.

   ❑ Protocols are not strong enough

   ❑ Complacent attitude

   ❑ Paramedics not comfortable with application

   ❑ Paramedics not comfortable with analysis

   ❑ Emergency Departments lack of acceptance of prehospital diagnostics

   ❑ Paramedics feel they are too close (geographically) to Emergency Department

   ❑ _____

Appendix B

ALTAMONTE SPRINGS FIRE DEPARTMENT
MEMORANDUM
HEALTHCARE SERVICES

Date: **April 30, 1999**

To: **Seminole County EMS System Paramedics**

From: Terry Winn, Assistant Chief

Subject: **12-lead ECG Survey**

The Altamonte Springs Fire Department is currently reviewing the use of 12-lead electrocardiography in the prehospital setting. This review will focus on the justification of expense for supplying the technology vs. the outcome. Additionally, if the outcome is shown to be effective, how we can increase the use of the technology by our Paramedics. As part of a research program to answer these questions and at the same time to meet the requirements for an applied research project for the Executive Fire Officer (EFO) program at the National Fire Academy (NFA), please find the enclosed "12-lead ECG"survey.

I would ask that you complete this survey and return it at your earliest convenience. You may remain anonymous. The information gathered from this survey will be combined with information from other departments nationwide. The compiled information will then be used to develop and institute a strategy for the provision of 12-lead technology in the future for the Altamonte Springs Fire Department.

You may return the survey to me by inter-department mail or fax to 407-263-3732. THANKS in advance for your assistance.

Appendix C

Altamonte Springs Fire Department
12-lead ECG Survey- Departments

1. Identify the size of your department:

   ❑ Less than 50 ❑ 51-100 ❑ 101-250 ❑ 251-500 ❑ Over 500

5. Identify the EMS services you provide (check one):

   ❑ BLS ❑ ALS First Response ❑ ALS Transport

   If you answered BLS- you do not need to continue.

6. Do you provide prehospital 12-lead ECG monitoring/analysis?

   ❑ Yes ❑ NO

   If you answered NO- you do not need to continue

7. In your opinion, do your paramedics utilize the technology as often as it could be used?

   ❑ Yes ❑ No ❑ Unsure

8. If you answered No or Unsure to #4, please check or list those reasons which you feel apply.

   ❑ Protocols are not strong enough

   ❑ Complacent attitude

   ❑ Paramedics not comfortable with application

   ❑ Paramedics not comfortable with analysis
   ❑ Emergency Departments lack of acceptance of prehospital diagnostics
   ❑ Paramedics feel they are too close (geographically) to Emergency Department
   ❑ _____

Copies of any programs, policies or procedures that are currently in use will be greatly appreciated.
Thank you for your assistance in completing this survey

Appendix D

April 30, 1999

Greetings:

The Altamonte Springs Fire Department is currently reviewing the use of 12-lead electrocardiography in the prehospital setting. This review will focus on the justification of expense for supplying the technology vs. the outcome. Additionally, if the outcome is shown to be effective, how we can increase the use of the technology by our Paramedics. As part of a research program to answer these questions and at the same time to meet the requirements for an applied research project for the Executive Fire Officer (EFO) program at the National Fire Academy (NFA), please find the enclosed/attached "12-lead ECG"survey.

I would ask that you complete this survey and return it at your earliest convenience. The information may be faxed to me at 407-263-3732 or you may E-mail me at <winn@altamontefire.org> for an electronic copy. The information gathered from this survey will be combined with information from other departments nationwide. The compiled information will then be used to develop and institute a strategy for the provision of 12-lead technology for the Altamonte Springs Fire Department.

Thank you for you time and consideration. If you would like a copy of the completed project, please make a note of that fact on the survey and include your name and address.

Sincerely,

Terry Winn
Assistant Chief

Appendix E

SEMINOLE COUNTY EMS SYSTEM
Thrombolytic Eligibility Checklist

Patient Name	Date	Time	CAD Number	Crew State Number JA#

If all Exclusion answers are NO and all Inclusion answers are YES (shaded area) contact the receiving hospital with an "AMI" alert, or with a "BRAIN" alert. Continue to follow practice parameters 2-9 for MI or 2-23 for CVA

Absolute Exclusion Criteria	Yes	No
1. Hx of known active bleeding or bleeding disorders		
2. Hx of GI bleed in last 21 days		
3. Hx of prior CVA, Tumor, Aneurysm or AV malformation		
4. Significant surgery in last two weeks, including eye surgery		
5. B/P - Systolic BP greater than 180, Diastolic BP greater than 130		
6. CPR performed on patient lasting more than 10 min within last 14 days		
7. Significant Trauma within last 3 months?		
8. Non-Compressible puncture sites or recent biopsy		
9. Received APSAC, Strepto in the last 2 years		
Relative Exclusion Criteria	**Yes**	**No**
10. Pregnancy or within 10 days post partum		
11. Taking blood thinners?		
12. Hx of terminal or advanced CA?		
13. Hx of liver, kidney problems, Diabetes, Colitis, or Crohns disease?		
14. Patient has permanent pacemaker?		
15. Pericarditis or mitral valve prolapse		
16. Recent Lumbar Puncture		

AMI Inclusion Checklist	Yes	No	CVA Inclusion Checklist	Yes	No
1. Chest pain less than 6 hours in Duration			1. Age greater than 18 years?		
2. Patient Oriented?			2. Pt shows no seizure activity at onset of CVA		
3. Age Greater than 18 years?			3. Onset of symptoms less than 180 minutes?		
4. 12 Lead ECG reveals MI in 2 leads			4. Blood glucose range is over 40 mg/dl		

Appendix F

ASFD 12 Lead Mounting Form

ALTAMONTE SPRINGS FIRE/RESCUE
2 LEAD

R #:_____ NAME:_____ DATE:_____